# How spatial segregation changes over time: sorting out the sorting processes

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# How spatial segregation changes over time: sorting out the sorting processes


## Abstract

Although there is strong evidence that segregation on socio-economic lines has risen in the many countries over the last few decades, comparatively little is known about the processes by which this happens. While it is often assumed that selective migration is the dominant process, this is rarely demonstrated. This paper proposes a more comprehensive framework to analyse processes driving changes in segregation – a 'neighbourhood accounts' framework. The framework is tested using data from the Scottish Longitudinal Study for 1991-2001, focussing on the working-age population. Contrary to what many have assumed, selective migration is shown to have only a very weak impact on changes in spatial segregation and is certainly not the dominant factor, at least in this particular context. The effects of ageing or cohort replacement and of uneven rates of status change or social mobility appear much more important. This raises important issues for policies to tackle segregation.



## Key words

Spatial segregation/ Neighbourhood change/ Neighbourhood dynamics/ Selective migration/ Residential mobility/ Scottish Longitudinal Study

## How spatial segregation changes over time: "sorting out the sorting processes"

### 1. Introduction

A great many studies have charted the growing polarisation of the population on socio-economic lines within the UK and within other developed countries in recent decades. There are important variations over time and between places, and differences between groups in terms of the pace and sometimes the direction of change but, in general terms, socio-economic segregation has been rising, reflecting rising social inequality (Dorling and Rees, 2003; Fahmy et al, 2011). Rising segregation is widely regarded as problematic due to the evidence on 'neighbourhood effects' – in particular, the negative impacts on individual welfare and economic efficiency that arise from having neighbourhoods with high concentrations of deprivation (Ellen and Turner 1997; Galster 2007; van Ham et al 2011). Although there are many methodological challenges in providing robust evidence on these effects and the overall results remain contested, there has been a notable policy response to these arguments. A range of interventions have been instigated in many countries, aiming to reduce or at least limit rises in segregation, and to promote the development of "mixed-income communities" (Galster forthcoming 2012; Bolt and van Kempen forthcoming 2012).

In spite of this, very little attention has been paid to the processes by which changes in spatial segregation occur, either at the level of individual neighbourhoods or for the system as a whole. It appears to be taken for granted that selective migration is the only process at work redistributing people with different statuses between places, or certainly the dominant one.

Direct evidence on these sorting processes is very limited, tending to focus on one or at most two possible processes. The current paper therefore seeks to fill this gap by 'sorting out the sorting processes'. It develops a new and more comprehensive analytical framework for decomposing aggregate change in a neighbourhood's socio-economic composition into its underlying processes. In doing so, it provides a means of identifying the processes driving changes in spatial segregation overall.

In the next section, the paper examines existing work on the processes driving change in spatial segregation, drawing on the literatures relating to economic and other forms of segregation. From this review, the paper proposes a 'neighbourhood accounts' framework, identifying all the flows or processes that drive neighbourhood change. In the third section, the paper discusses the dataset and methods used to illustrate how the framework operates and, in the fourth section, it presents the results of an initial implementation of the framework. The fifth concludes with a discussion of the substantive results and directions for further research.

## 2. Processes of neighbourhood change

### *Status change and selective migration*

Many studies have measured changes in the degree of spatial segregation or polarisation over time or have tracked changes in the number of highly deprived neighbourhoods (Massey and Eggers, 1990; Jargowsky, 1997; OECD, 1998; Dorling and Rees, 2003). Between them, these studies have used a range of measures or indicators of socio-economic status, and they have analysed change at a variety of spatial scales. The picture of growing polarisation that emerges is fairly consistent although it varies over time and between places.

Since it relies heavily on cross-sectional data, however, that research is unable to identify the processes by which change occurs (Quillian, 1999). Where these processes are considered, it is often *assumed* that selective migration is the dominant influence; see, for example, the entertaining fictional scenario in the introduction to Dorling and Rees' paper. Selective migration is implicitly linked to a second process – status change or social mobility in the loose sense. Individuals see changes in their status over time as incomes or wealth rise or fall. These status changes are seen as leading to selective migration as people re-sort themselves to keep their neighbourhood status in line with their social status. Selective migration is also seen as the mechanism by which increasing social inequality is translated into rising spatial segregation (Massey and Fischer, 2000; Cheshire et al, 2003).

These views reflect the wider urban geography literature which has long used selective migration to explain how neighbourhoods change through processes of succession, filtering or displacement (Evans 1985; Grigsby et al 1987). This perspective is also apparent in neighbourhood regeneration policies in the UK. Migration is assumed to be the key process maintaining concentrations of disadvantage in the poorest neighbourhoods in the face of spatially-targeted interventions or area-based initiatives which seek to improve life-chances for residents. These investments may lead to improvements in residents' economic status, it is argued, but this simply fuels selective out-migration: "those who get on, get out" (SEU, 1998 and 2000; Cheshire et al, 2003).

In spite of the apparent consensus, there are significant reasons to be sceptical over the role of selective migration. This is not to argue that selective migration does not operate to reinforce segregation at all. Rather, the point is that it may not be the only process at work – or indeed the most important. First, ample evidence has shown that housing needs or demands

dominate mobility decisions, not reactions to neighbourhood contexts (Rossi, 1980; Kearns and Parkes 2003; Rabe and Taylor 2010). Connected to this point, mobility rates are closely related to age, with young adults having mobility rates three or four times greater than older adults (Bailey and Livingston 2007). Together these factors indicate that, at the very least, migration is unlikely to be an efficient sorting mechanism in relation to neighbourhood status. Flows are characterised more by high levels of 'churn' than by strong selectivity (Gramlich et al 1992). This is further reflected in the fact that a significant proportion of moves are horizontal or between neighbourhoods with similar statuses (Bailey and Livingston 2007).

Second, the selectivity of migration may vary depending on the indicator of socio-economic status used. This reflects complex relationships between age, status and selective migration. Young adults tend to move down the hierarchy of neighbourhoods as they leave the parental home to begin their housing and labour market careers, reflecting their constrained resources at this stage. (The term 'hierarchy' refers to differences in socio-economic status and hence housing costs between neighbourhoods although it is recognised that neighbourhoods differ in other respects as well.) As they age, they tend to move up the neighbourhood hierarchy, reflecting gains in income and wealth. This age-related churning of the population through the neighbourhood system has been termed the "demographic conveyor" (Bailey et al, forthcoming 2012). The analogy is with a term used in climate science where the slow-moving but massive 'overturning' of ocean waters – currents such as the 'North Atlantic conveyor' – have been shown to have fundamental impacts on the redistribution of energy around the Earth and hence on variations in climatic conditions (Houghton 2009). Here the term is designed to describe the steady 'overturning' of population across the system of neighbourhoods, which brings into more deprived neighbourhoods a flow of relatively young adults who also tend to be healthier, better educated and in better paid employment than existing residents.

The actual scale of flows through selective migration and their impacts on economic segregation have rarely been measured, let alone considered alongside other processes, although the literature on this topic is growing. The most substantial contributions have been in the US where research sought to explain the rising concentrations of poverty, particularly for African American households, which were observed during the 1980s. The core of the debate revolved around the relative contributions of three processes: selective outmigration from high poverty neighbourhoods by more affluent African American households (Wilson, 1987); racially-selective status change (downward social mobility) for existing residents of these neighbourhoods, driven by industrial restructuring (Jargowsky, 1997); and racially segregated housing markets which channelled rising poverty for African American households into ghettos defined by race as much as by class (Massey et al, 1994).

Following initial work by Gramlich et al (1992), Massey et al (1994) used longitudinal survey data to examine the impacts of geographic and social mobility, explicitly seeking to test the three competing perspectives. They argue that their results support their own racial discrimination thesis most strongly, but their work is hampered by the focus on transition probabilities rather than actual flows. As Quillian (1999) noted, without also factoring in the size of different population groups, these probabilities do not reveal the relative size of particular flows and hence their relative impact on population composition of different areas. A further weakness is that Massey et al (1994) look at transition probabilities solely in terms of where people move from, not where they move to. Yet understanding the latter is vital to understanding how such moves re-shape the concentrations of different groups.

Going beyond these earlier studies, Quillian (1999) examines flows directly, decomposing changes in neighbourhood composition between selective migration and status change for

non-movers; he also explores how neighbourhood change affects non-movers. His findings go some way to reconciling the competing arguments of Wilson and Massey. He finds substantial migration by nonpoor African Americans into nonpoor White neighbourhoods as Wilson predicts. At the same time, racial segregation continues as Massey hypothesises, as many Whites respond by moving on from those same neighbourhoods.

Generalising from these results is rather difficult. One limitation is that the work has been conducted on the particular US context. The US is not only marked by particularly high levels of residential mobility, but is also a country where economic segregation is intertwined with ethnic segregation to a degree not apparent in Europe. None of the studies attempts to report results solely on the basis of economic segregation. Neighbourhoods are classified by poverty and ethnic status. A second limitation is that the work focuses solely on the poorest neighbourhoods. It is possible for deepening concentrations of poverty in such extreme neighbourhoods to coincide with falling levels of segregation across the system as a whole. Similarly, the processes driving change in the poorest neighbourhoods may not be the same as those operating in other kinds of place. A third limitation is that this work ignores other processes which may be at work – a fact acknowledged at least by Quillian (1999), and discussed further below.

Elsewhere, attempts to examine the processes by which economic segregation changes are relatively few. For the UK, a small number of studies have been conducted, primarily using bespoke mover surveys. Bailey and Livingston (2008) discuss the problems with such work, notably the small sample sizes involved and the high potential for bias, and the focus on small numbers of neighbourhoods. Their own analysis used one-year migration data from the 2001 Census, covering all neighbourhoods in England and Scotland. Using educational attainment as the indicator for economic status, they found that selective migration did

reinforce segregation, but that the magnitude of the effect was surprisingly small. Using data from a single Census, that analysis was unable to measure status change nor any of the other processes discussed below; this paper goes considerably further, by using longitudinal Census data.

In Sweden, analyses of migration have been made using population register data. Andersson and Bråmå (2004) consider status change and selective migration, finding that the latter reinforces existing patterns of segregation as expected. Crucially, however, their work does not consider the absolute scale of the impact of migration flows on segregation. It does not show whether these flows are sufficient to explain observed changes in structures, and it does not consider whether other processes may be at work.

### *Natural change*

By contrast with the literature on economic segregation, research work on ethnic segregation has paid close attention to the processes driving neighbourhood change and has used this understanding to challenge the stereotyping or pathologising of minority ethnic groups in much political discourse. One strand of this work focuses solely on the role of selective migration in deepening ethnic segregation. This explores the extent to which ethnic segregation is produced by the actions of minority or majority groups: the “white flight” and “white avoidance” literature (Clark 1992). Another strand, however, has aimed to decompose changes in ethnic concentrations between two processes: migration and natural change (Simpson, 2004; Finney and Simpson 2009; Musterd and De Vos, 2007). For the locations examined, these studies show that rises in minority ethnic concentrations are the result of two opposing processes – higher levels of *natural growth* by minority ethnic groups than the White majority in areas of existing concentration, offset by net *out-migration* of minority ethnic households from these areas. This evidence directly challenges the view that

concentrations are the result of a conscious desire for ‘self-segregation’ on the part of minority ethnic groups as much political rhetoric has claimed (Home Office, 2001).

### *Other processes*

A number of other processes may also operate to change levels of segregation over time. First, where one is concerned with a particular age group rather than the entire population, ageing processes or cohort replacement may have an impact as individuals enter or leave the group of interest. For example, employment or unemployment rates for a neighbourhood may be affected by the ‘outflow’ of people reaching statutory retirement age and the ‘inflow’ of young adults reaching working age. Of course, neighbourhoods do not necessarily change merely because an individual passes some arbitrary threshold; a ‘poor’ 64 year old is likely to become a ‘poor’ 65 year old. Nevertheless, where the concern is with a particular age group, ageing must be taken into account as well.

Second, since residential segregation is concerned by definition with the household population, moves between that group and the non-household population may also have a bearing on segregation. Many of these exchanges may be spatially fairly neutral (moves to long-term residential or nursing care, for example). Other exchanges, such as the flows into and out of prison, may have the effect of reinforcing segregation.

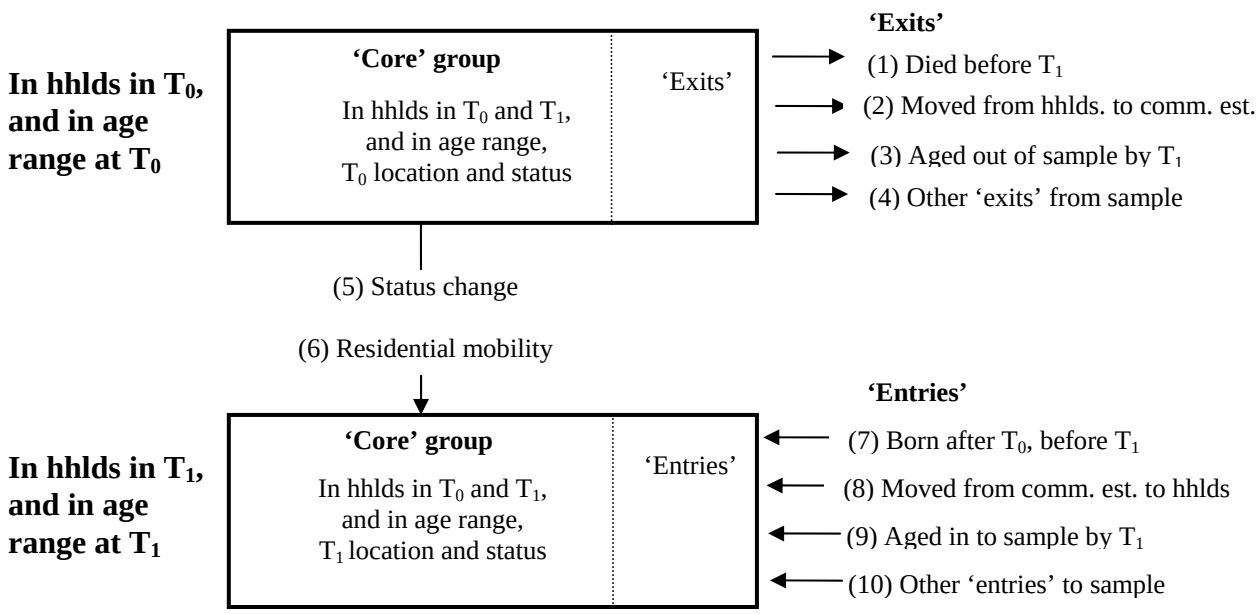
Third, there are other flows which bring people into or take them out of the observed population. This is partly due to external migration flows. Since residential segregation is concerned with a set of neighbourhoods in a particular region or country, immigration and emigration may have an impact on segregation. It is also due to data coverage. With studies based on repeated cross-sections, the scale and nature of missing data at different times may have an impact. Changes in the definition of the population base or the place of usual

residence (e.g. for students) may also have an impact. With longitudinal data, sample attrition or accretion may be important. In practice, the two kinds of flows will be difficult if not impossible to separate.

### *Neighbourhood accounts framework*

Drawing on the above analysis, this paper therefore proposes a 'neighbourhood accounts' framework to identify on a comprehensive basis the various flows that may lead to changes in spatial segregation over time (Figure 1). This shows how certain characteristics or statuses may be redistributed between two time points, $T_0$ and $T_1$. It is readily apparent that status changes and selective migration are just one part of the picture, applying only to the population present and captured at both time points. In addition, four flows cause people to 'exit' the system of neighbourhoods while another four flows cause them to 'enter' it. The 'other' exits and entries cover both external migration and sample attrition or accretion. Not all flows may be relevant in every case. If the concern is with the whole population, ageing in and out will not be relevant. Births will only be relevant if the group of interest starts at age zero. The key point is that each of these eights flows may be spatially uneven or selective, and so impact on segregation.

*Figure 1: Neighbourhood accounts framework*




## 3. Data sources and methods

### *The Scottish Longitudinal Study*

In the empirical section that follows, the neighbourhood accounts framework is operationalised using data from the Scottish Longitudinal Study (the SLS); see Boyle et al (2009) for details. The SLS follows the format of the Office for National Statistics Longitudinal Study for England and Wales (the ONS-LS). Records from the 1991 and 2001 Censuses are extracted for all individuals with a birthday on one of a fixed list of dates giving a simple random sample of the population. The sample fraction in the SLS is larger than the ONS-LS (5 per cent compared with 1 per cent). These records are matched between Censuses where possible, and anonymised to provide a longitudinal research dataset. Deaths of sample members are noted from death registrations (where these occur within Scotland) and new

entrants are noted from birth registrations. Of those present in 1991, some 12 per cent could not be traced in 2001 nor accounted for through deaths or known moves out of Scotland (Boyle et al, 2009). This paper focuses on the core working age population, defined as people 25-64 and living in a household in Scotland at either Census.

As the UK Census has never collected data on incomes, three indicators of socio-economic status are used: educational attainment, employment status and occupational status. Educational attainment has been used in previous work on selective migration (Bailey and Livingston 2007, 2008) so was retained here partly for comparability. In 1991, the Census asked only about higher level qualifications (degrees, professional qualifications and similar) so that is the indicator used at both time periods. Employment status compares those in paid work with all others, unemployed or inactive. Occupational status is measured using the social class variable originally constructed for the 1991 Census, based on a combination of occupation and employment status. Although originally coded for only 10 per cent of the population for Census outputs, 1991 data was coded for all those in the SLS. For 2001, a comparable social class variable was derived within the SLS, using occupation and employment status in 2001, coded using 1991 classifications.

Critically for studies of neighbourhood change, the SLS data have been linked to a unique set of 'neighbourhood' boundaries that provide stable geographies over time. These are the Continuous Areas Through Time (or CATTs) (Exeter et al, 2005). Any change in an individual's recorded location can therefore be regarded as being the result of a move rather than a change in neighbourhood boundaries so it is possible to get an accurate measure of the scale and nature of migration. The CATTs have an average population of 500 people making them comparable to the units widely employed in Scotland for neighbourhood statistics (the

Datazones – average population 750 – see Flowerdew and Feng, 2002). Their main disadvantage is that they vary widely in size (from a population of 50 to one of over 15,000).

Deprivation scores for the CATTs in 1991 and 2001 have been added to the SLS. These provide a rounded measure of levels of material deprivation by combining several individual indicators. Carstairs scores are used here and these are a widely used indicator of socio-economic deprivation, based on a combination of four rates for each area: male unemployment, overcrowding, lacking a car and low social class (Carstairs and Morris 1991).

With very small units, the sample in the SLS is so small that measures of flows would be subject to very high levels of random 'noise'. To reduce this problem, small CATTs are aggregated together. Scotland was first divided into eight regions. Within each region, all the CATTs below the minimum population threshold were aggregated together with the other small CATTS in the same deprivation decile. These small CATTs are therefore joined with areas broadly similar in characteristics but not necessarily contiguous. This is a slighly crude process but it is sufficient for the purposes of illustrating the methods that have been developed. People are counted as movers if they are in a different (aggregated) CATT in 2001 than in 1991.Some moves between areas with similar levels of deprivation will be missed as a result but this kind of 'horizontal' move does not impact on socio-economic segregation. If small CATTs had been merged into neighbouring areas with possibly quite different levels of deprivation, some important selective migration flows might have been lost. In the analysis presented here, CATTs were aggregated together if they had a sample of less than 10 individuals. This reduced 10,023 CATTs to 5,589 areas which are either individual CATTs or groups of small CATTs; these are still refered to as CATTs for simplicity. The average number of cases per CATT rises from 17 to 30 in the process. The

impact of using higher population thresholds was tested but this did not significantly alter the overall picture presented below.

### *Measuring segregation*

A key aim of this paper is to identify how spatial segregation changes over time. The choice of an appropriate measure of segregation is therefore important. Segregation is a term which can refer to different aspects or dimensions of spatial distribution, although most commonly it refers to the ideas of evenness or exposure (Massey and Denton, 1988; Simpson 2007). In this paper, the focus is on evenness – the extent to which groups are spread equally across different areas of the country – since this is the concept most clearly aligned with theoretical and policy debates about 'mixed communities' for example.

Even within this dimension, there has been an intense debate over the most appropriate means of measuring evenness; this shows no signs of abating, as recent exchanges over measures of school segregation in the UK have shown (Gorard and Taylor 2002; Allen and Vignoles 2007; Gorard 2007; Johnston and Jones 2010). In general, there is a view that different segregation measures are closely related and tend to move in the same direction so the choice may have little impact on results in most cases (Gorard 2007). Nevertheless, measures have important differences that one should be aware of.

Ideally, a range of measures might be employed but, for the sake of this initial investigation, one is selected. The Index of Dissimilarity was chosen, partly on the basis that it has been in widespread use for some time and partly for one of its properties, discussed below. The Index of Dissimilarity, D, measures how evenly two groups are distributed across a set of neighbourhoods. Here the focus is on the distribution of one group ($x$) relative to the rest of the population ($y$). The numbers of people in each group in neighbourhood i are denoted $x_i$

and $y_i$ respectively, with the totals in each group across the region or country denoted *X* and *Y*. The Index of Dissimilarity, D, is given by:

$$D_{xy} = 1/2 * \Sigma | (x_i/X - y_i/Y) | \qquad \text{(Duncan and Duncan, 1955)}$$

An alternative is the Index of Segregation, $S_x$, which measures the evenness of the distribution of group *x* with respect to the whole population, ($t_i$ and *T*), where

$$S_x = 1/2 * \Sigma | (x_i/X - t_i/T) | \qquad \text{(Allen and Vignoles, 2007)}$$

The Index of Dissimilarity is preferred to the Index of Segregation (which was used by Dorling and Rees 2003, for example) because it is unaffected by the size of the group being considered. While the Index of Dissimilarity always runs from 0 to 1, the Index of Segregation has an upper limit determined by the size of the group, *x*. If $p_x$ is the proportion of *x* in the total population (X/T), then the upper limit of $S_x$ is (1-p) (Allen and Vignoles 2007). This implies that one needs to be extremely careful when using the Index of Segregation to make comparisons over time as the meaning of a particular value of $S_x$ is dependent on the share of *x* in the overall population (Allen and Vignoles 2007).

Another way of conceiving of $S_x$ and $D_{xy}$ is that $S_x$ is the proportion of group *x* which would have to move neighbourhoods in order to have a distribution the same as the *current* population while $D_{xy}$ is the proportion of group *x* which would have to move to have the same distribution as group *y* (here, the rest of the population). The moves implied by $S_x$ would not be sufficient to remove segregation but those implied by $D_{xy}$ would be.

## 4. Analysis

The analysis starts by examining the relative size of the different flows identified in the neighbourhood accounts framework, and examines how these vary by age. It then goes on to explore the impacts of each flow on changes in spatial segregation.

### *Scale of flows*

*Exits and entries*

The data extracted from the SLS initially contained all individuals who were 25-64 in either 1991 or 2001. A small number of cases were excluded as individuals were not in a private household at either time period or because the ages recorded in 1991 and 2001 did not correspond (8 per cent of cases). Other cases were excluded because they did not have valid data for the relevant status variable: educational attainment, employment status or occupational status. The number of cases in each analysis therefore varies slightly due to different levels of missing data. Missing data is a slightly larger problem with occupational status (16 per cent, compared with 6 per cent for the other two) but is generally quite low. Cases with missing data are more likely to be older on average but appear across all age groups.

Our sample therefore covers people in the target age range in 1991 or 2001, and in the household population at one or both times. Table 1 shows seven of the entry and exit flows identified in Figure 1; births are not relevant since the focus is on the working age population over a ten year period, while status change and migration are dealt with below. Overall, the number of valid cases does not change much between 1991 and 2001 but there are very large changes in the underlying population as a result of exits and entries. Over one third of the

people present in households in 1991 exit the sample by 2001, to be replaced by a similar number of new cases. In other words, when we compare segregation within the household population in 1991 to that in 2001, the population we are looking at is composed of a very different group of individuals. The scale of the change is greater here because the focus is on a particular age group rather than the whole population. Nevertheless, the magnitude of this turnover is obscured in cross-sectional studies.

The largest flows are the 'other exits' and 'other entries' (the combined effects of sample attrition or accretion, and of migration in to or out of Scotland), along with the effects of ageing or dying. Moves between private households and communal establishments account for just 1 per cent of flows in each direction and are omitted from subsequent analyses as they have such a limited impact on segregation.

The different processes affect very different groups of people in terms of age. It is important to understand these relationships, as age is strongly related to both the likelihood of moving home and the direction of moves in terms of the neighbourhood hierarchy (Bailey and Livingston 2007). The 'exit' flows tend to remove older people from the sample (over half of all exits are 55-64 in 1991) while 'entry' flows bring in younger people (two-thirds of entries are 25-34 in 2001). Deaths are much more common for older adults, as are exits to communal establishments while, by definition, those ageing out of the sample are over 55 in 1991. By contrast, the 'other exits' have quite a young profile. This could be related to the higher incidence of missing data for younger adults and hence higher attrition rates (GROS 2006). Alternatively, it might be migration to places outside Scotland; in 2009/10, at least, adults 16-34 represented a quarter of the total population of Scotland but half of all migrants into or out of the country (National Records of Scotland, 2011). 'Other entry' flows are quite similar in

age structure to 'other exits', and this would be consistent with either sample accretion or migration explanations.

*Table 1: Entry and exit flows by age*

| | **Cases** | | **Row percentages** | | | |
|---|---|---|---|---|---|---|
| | | | ***Age in 1991*** | | | |
| | | | ***25-34*** | ***35-44*** | ***45-54*** | ***55-64*** |
| **1. Present in hhlds, 25-64 in 1991** | **129,324** | | **30%** | **27%** | **22%** | **21%** |
| ***Exits*** | ***47,186*** | ***100%*** | ***17%*** | ***13%*** | ***12%*** | ***57%*** |
| 2. % die before '01 | 7627 | 16% | 5% | 11% | 25% | 59% |
| 3. % to comm. est. in '01 | 388 | 1% | 18% | 16% | 19% | 47% |
| 4. % age out of sample | 19192 | 41% | 0% | 0% | 0% | 100% |
| 5. % other exit | 19979 | 42% | 38% | 27% | 19% | 16% |
| ***6. Core*** | ***82,138*** | | ***37%*** | ***35%*** | ***28%*** | |
| (% of 1991 total) | (64%) | | | | | |
| | | | ***Age in 2001*** | | | |
| | | | ***25-34*** | ***35-44*** | ***45-54*** | ***55-64*** |
| ***Entry*** | ***49,767*** | ***100%*** | ***67%*** | ***15%*** | ***10%*** | ***7%*** |
| 10. % from comm. est. in '91 | 529 | 1% | 44% | 26% | 17% | 13% |
| 11. % age in to sample | 25273 | 51% | 100% | 0% | 0% | 0% |
| 12. % other entry | 23965 | 48% | 34% | 31% | 20% | 15% |
| **13. Present in hhlds, 25-64 in 2001** | **131,905** | | **25%** | **29%** | **26%** | **20%** |
| - % change '91-'01 | 2% | | -5% | 2% | 3% | -1% |
| **Valid cases** | **179,091** | | | | | |

Source: Scottish Longitudinal Study.
Notes: The 95% confidence intervals for percentages in this Table are +/- 0.2 per cent at most. The numbers included in the labels in column 1 correspond with flows shown in Figure 1. The Table shows the situation when educational attainment is used as the status variable. Figures are very similar when employment status or occupational status variables are used. With the former, the number of cases declines by 7 per cent between 1991 and 2001 while, with the latter, it rises by 4 per cent.

*Status change and residential mobility*

For individuals who exit or enter the sample, there is data on their residential location and their status only for one point in time. For the 'core' group, however, there is data on both of these characteristics for 1991 and 2001, so it is possible to look at rates of status change and

residential mobility, and at the relationships between these two (Table 2). It should be remembered that, as with any study which tracks a group of people over time, the analysis is dealing with a group that gets older, so ageing processes are an important influence on patterns.

*Table 2: Size of flows – migration and status change*

| | **Degree or similar** | **Employed** | **Occupational status:** | | | |
|---|---|---|---|---|---|---|
| | | | Semiskilled/ Unskilled (IV/V) | Skilled Manual (IIIM) | Skilled Non-Manual (IIINM) | Professional, Managerial/ Intermediate (I/II) |
| % in group in 1991 | 20% | 77% | 23% | 21% | 23% | 33% |
| % in group in 2001 | 27% | 72% | 23% | 20% | 21% | 37% |
| **% changing group** | **10%** | **25%** | **17%** | **14%** | **16%** | **18%** |
| - % move into group | 9% | 10% | 8% | 6% | 7% | 11% |
| - % move out of group | 1% | 15% | 8% | 8% | 9% | 7% |
| **Net change in status by age in 1991** | | | | | | |
| **All** | **8%** | **-6%** | **0%** | **-1%** | **-2%** | **4%** |
| 25-34 | 10% | 8% | -2% | -2% | -4% | 5% |
| 35-44 | 8% | -1% | 0% | -2% | -2% | 5% |
| 45-54 | 5% | -29% | 2% | -1% | 0% | 6% |
| **% moving, of which:** | **41%** | **41%** | | **41%** | | |
| - % move down | 36% | 36% | | 37% | | |
| - % move up | 47% | 47% | | 47% | | |
| - % move sideways | 17% | 17% | | 16% | | |
| - net (up - down) | 10% | 10% | | 11% | | |
| **Net change in status by moving:** | | | | | | |
| - moving down | 10% | -3% | 0% | -1% | -3% | 5% |
| - moving up | 10% | -2% | -1% | -2% | -3% | 6% |
| - not moving/move sideways | 7% | -8% | 0% | -1% | -2% | 3% |
| Number of cases | 82,138 | 77,609 | 74,898 | 74,898 | 74,898 | 74,898 |

Source: Scottish Longitudinal Study.

The number of people recorded as having a degree or similar qualification rose significantly over this time period (from 20 to 27 per cent). Some of this increase will reflect genuine changes in status, where people complete higher qualifications as mature students or gain professional qualifications equivalent to degrees through work. In other cases, it may reflect changes in Census question wording and output categories for this particular item. Although it should not be possible to see a decline in educational attainment over time, a small number of people are recorded as flowing from the more to the less qualified group (1 per cent). Gains in qualifications are greater for younger age groups, however, which is what would be expected.

With employment status, the number of people regarded as employed actually fell (from 77 to 72 per cent). This may seem surprising given that employment levels rose in Scotland during the 1990s. It should be remembered that this part of the sample ages by 10 years between the two Censuses, so the decline reflects a propensity for early retirement and other forms of inactivity for older age groups. This can be seen by the net rise in employment for those 25-34 in 1991 (by 8 per cent) but the sharp drop for those 45-54 (by 29 per cent). The last four columns show changes in occupational status for four different groups. Gross flows are relatively large with around one-in-six recording a change in occupational status, but net changes are much smaller. There are slight falls in the proportion regarded as skilled manual or non-manual workers, and a rise in those regarded as in professional/managerial or intermediate groups.

In gross terms, migration flows look much larger than status changes. Of those present in 1991 and 2001, 41 per cent have moved between CATTs. Relatively few migrants have moved sideways, remaining in the same deprivation band in 2001 as in 1991 (17 per cent of movers). Nevertheless, when added to the non-movers (59 per cent), three quarters of people

lived in a neighbourhood with the same level of deprivation in 2001 as in 1991. For the remainder of the movers, most of the flows up and down the neighbourhood hierarchy cancel each other out, although there is a net shift upwards; 47 per cent of movers move to a less deprived neighbourhood compared with 36 per cent who move to a more deprived neighbourhood. (Figures vary slightly depending on which status variable is being considered due to slight differences in the number of cases arising from missing data.) This net upward movement is what would be expected for a group of adults who are 25 to 54 at the start and who age by ten years, given the 'demographic conveyor' effect noted above.

More strikingly, there is very little interaction between changes in status and the direction of mobility. One might expect moves up the neighbourhood hierarchy to be associated with upward status moves. In practice, however, the net status change for those moving up is virtually identical to the net status change for those moving down in every case. The key difference is actually between those who move up or down, on the one hand, and those who do not move or who move sideways. Looking at educational qualifications, for example, those moving down and those moving up both showed a net increase of 10 per cent holding a degree, compared with 7 per cent for non-movers. For employment status, those moving up saw employment levels fall by 2 per cent, very similar to the fall of 3 per cent for down movers, but both much higher than the 8 per cent fall for non-movers. Again, the explanation for this is partly connected to age. Young adults are much more mobile than older adults (Bailey and Livingston 2007), and this is the group that showed greater gains in qualifications and lower losses in employment.

### *Changing spatial segregation*

The results in the previous section are an early indication that we should not expect migration to be a major influence on changes in the spatial distribution of the population, at least for

these status characteristics. The flows up and down are nearly equal in size, and they do not differ very markedly in composition. The paper now moves on to show how the impact of each of these flows on spatial segregation can be measured. These impacts depend partly on the size of the flow but also on the extent to which each is selective with respect to neighbourhood characteristics. Unlike the US literature discussed above, the approach here is to assess the impacts of each flow on segregation across the system of neighbourhoods as a whole.

The overall trend has been for rising spatial segregation across the UK, although the underlying picture is more complex than is often assumed, with some groups becoming less rather than more segregated (Dorling and Rees 2003). For the groups examined here, spatial segregation actually fell between 1991 and 2001, as measured by the Index of Dissimilarity (Table 3). The reduction is particularly great for those holding higher qualifications although this may be influenced to some extent by the changes in question wording and classifications.

The contribution of each flow to changes in segregation is assessed by looking at the Index of Dissimilarity before and after each flow has occurred. For example, the combined effect of all the 'exit' flows can be estimated by measuring segregation for the household population 25-64 in 1991 and comparing this with the segregation for the 'core' sample that is left after all 'exits' flows have happened. To measure the effect of the individual 'exit' flows, levels of segregation for the same starting group are compared with the level once each individual exit flow has left the sample; the effect of each flow is measured separately from the same starting point. The sum of the individual effects may not be the same as that for all exits combined due to the complex ways in which the different flows overlap with each other, but this approach does indicate the relative importance of each flow.

*Table 3: Change in segregation through exits and entries*

| | **Educational attainment** *Degree or similar qualification* | **Employment status** *Employed* | **Occupational Status:** Semiskilled/ Unskilled (IV/V) | **Occupational Status:** Professional, Managerial/ Intermediate (I/II) |
|---|---|---|---|---|
| **Dissimilarity Indices** | | | | |
| 1991 | **40.0** | **25.4** | **29.5** | **32.0** |
| 2001 | **32.1** | **24.8** | **28.5** | **28.6** |
| **Change in Dissimilarity Indices** | | | | |
| ***Overall*** | ***-7.9*** | ***-0.6*** | ***-1.0*** | ***-3.5*** |
| ***Exits*** | ***0.0*** | ***4.2*** | ***2.7*** | ***0.5*** |
| - deaths | -0.4 | -0.1 | 0.4 | -0.1 |
| - age out | 0.0 | 2.6 | 1.0 | 0.3 |
| - other exit | 0.5 | 0.6 | 0.5 | 0.2 |
| ***Change for core group*** | ***-4.4*** | ***-2.0*** | ***-0.6*** | ***-1.4*** |
| - status change | -4.9 | -2.8 | -1.2 | -2.0 |
| - selective migration | 0.5 | 0.9 | 0.6 | 0.6 |
| ***Entry*** | ***-3.5*** | ***-2.8*** | ***-3.1*** | ***-2.5*** |
| - age in | -3.1 | -2.0 | -2.3 | -2.1 |
| - other entry | -1.4 | -1.4 | -1.4 | -1.0 |

Source: Scottish Longitudinal Study.
Notes: Flows between households and communal establishments omitted due to small size and impact.

With status change and selective migration, the order in which events occur is not known so the measures are based on the assumption that status change occurs first and migration second. This is, after all, the model implied by theories of neighbourhood change. The impact of status change on the 'core group' is measured by comparing the Dissimilarity Index in 1991 for people with their 1991 status with that for the same people with their 2001 status, but still in their 1991 locations. The impact of selective migration is then measured by taking people with their 2001 status, and measuring the change in the Dissimilarity Index as they move from their 1991 to their 2001 location. It is possible to measure the impacts of the two

flows the other way around, assuming migration occurs first. This tends to reduce the impact of both flows on segregation. Since the impact of selective migration is one of the core concerns, it is worth noting that the paper has used the method which provides the larger estimate of its impact.

*Entry and exit flows*

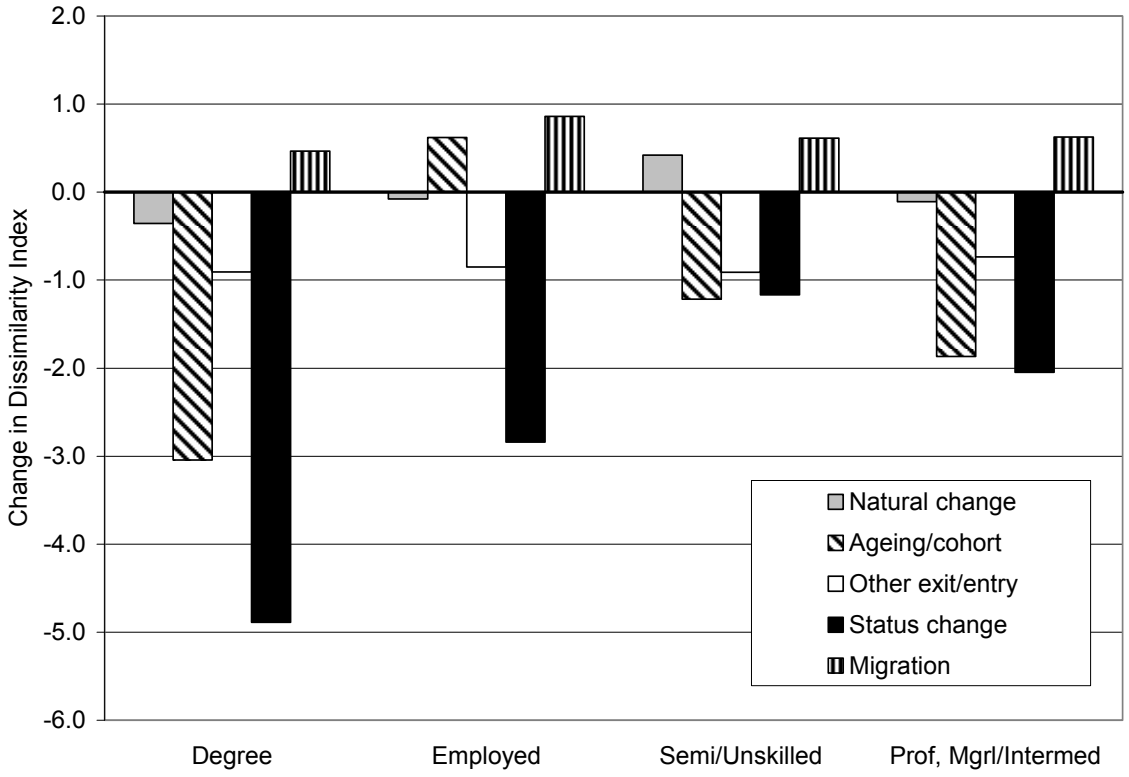
In general, exit flows act to increase segregation while entry flows tend to reduce it. As Table 1 showed, exit flows are dominated by older groups. These flows remove both high and low status individuals but they remove proportionately more high status individuals from lower status neighbourhoods, or more lower status individuals from higher status neighbourhoods. The result is an increase in segregation. Entry flows are dominated by younger groups and have the opposite impact. The net effect of entry and exit flows may be to raise or lower segregation but, once change for the core group is included, the net effect is a reduction for each of the four groups examined here.

Natural change (here, just deaths) acted to reduce levels of segregation for the three higher status groups but increased segregation for the lower status groups, although the effects were fairly modest in each case. Of people with degrees, for example, relatively more of those living in more affluent areas in 1991 had died by 2001. This makes sense since degree holders living in more deprived areas are likely to be younger. Again, this is evidence of the 'demographic conveyor' at work; it operates to bringing young adults with higher qualifications into relatively more deprived neighbourhoods – selective migration, but not in the direction expected. Older adults with qualifications will have tended to move to higher status neighbourhoods. The deprived neighbourhoods therefore lose relatively fewer of their degree-holding individuals through early deaths. With the low status occupational group, segregation rises as a result of deaths. Here the explanation is different. Lower status groups

tend to have higher mortality rates than higher status groups. The combination of being in this low status group and living in a more deprived neighbourhood is likely to be a marker of even lower status and hence higher risks of mortality.

The net effect of ageing into and out of the working age population (cohort replacement) is much stronger than that of natural change. Ageing out of the working age population raised segregation on three of our four status indicators while ageing reduces it in every case. The combined effect is shown in Figure 2, by simply summing the separate effects of ageing in and out. Thinking about employment status, for example, employment rates among 55-64 year olds will tend to be lower than amongst younger adults due to early retirement processes, reflected in Table 2. Removing these older groups through the ageing-out process therefore tends to raise employment rates but does so by more in the least deprived areas, suggesting that early retirement may be more common in more affluent areas. On the other hand, ageing-in brings in young adults who have relatively high employment rates. Compared to the established populations in more deprived areas, they are much more likely to be in employment, so reducing segregation. The net effect of cohort replacement is either close to neutral (employment) or reduces segregation.

*Figure 2: Net changes in segregation through main flows*




Source: Scottish Longitudinal Study. Crown copyright.

Notes: Net effects for ageing are the sum of the effects for ageing in and ageing out. Net effects for other exits and entries are the sum of the individual effects.

The 'other' entries and exits cover the combined effects of sample attrition or accretion, and external migration. As with ageing processes, other exits tend to increase segregation while other entries tend to reduce it, with the net effect a reduction in every case. As Table 1 showed, these flows have a relatively young profile. External migration between Scotland and the rest of the UK might be expected to be dominated by better qualified individuals who are more likely to be long-distance moves. Equally, the Census has been particularly likely to miss younger adults in smaller households (GROS, 2006). One explanation for the falling segregation that results is that the other entries were simply larger than other exits so more of

these relatively young individuals were recorded in 2001 than in 1991. As younger adults tend to have lower segregation, this reduces overall segregation.

*Status change and selective migration*

Finally, we turn to the changes affecting the 'core group' – that part of the population present in 1991 and 2001, and within the working-age population at both periods. Here changes in segregation are decomposed between status change and selective migration. The overall impact of status change is to reduce segregation and this is the most significant process in terms of net changes in segregation (Figure 2). There are several possible explanations for this. First, the theories discussed above predict this effect as, over time, the fit between individuals and their area weakens through social mobility. If people were not able to move, segregation would tend to fall as a result. Related to this, the effect can be thought of in terms of the 'demographic conveyor'. In tracking a sample over time, respondents age. Starting at 25, they tend to move up in their labour market careers and would be expected to move up in their neighbourhood careers as well. Second, there may also be the effects of economic cycles at work here. The 1990s were a period of fairly stable economic growth for Scotland. The impact of that may have been particularly beneficial for the most deprived areas, so reducing segregation.

The most striking finding, however, is that there is no counterbalancing adjustment through selective migration. This flow does act to increase segregation as expected but the effect is relatively weak, particularly when compared with the other processes at work. It is not sufficient to balance the effects of status change, as some theories of neighbourhood change would predict. Selective migration is not sufficient to offset the impacts of status change for any of the indicators examined, let alone the net effects of other processes. Nor can it be

argued that the effects of selective migration are being 'hidden' within the external migration flows. The net effect of 'other' entries and exits is to reduce segregation, not increase it.

## 5. Conclusions and discussion

The aim of this paper is not to attempt a comprehensive analysis of changes in patterns of spatial segregation but, rather, to illustrate a novel approach to disaggregating such changes – "sorting out the sorting processes" – and to show how its application yields new insights and new directions for research. The framework itself highlights the range of possible processes at work, while the data on the scale of the different flows draw attention to the high levels of population churn or turnover largely hidden or ignored in cross-sectional studies; over a third of people present in 1991 were not present in the sample in 2001. The picture of the neighbourhood system that emerges is a much more dynamic one, where stability and change are produced through the complex interaction of a wide range of processes, not simply status change and selective migration for a largely fixed group of individuals.

The findings from this initial analysis are certainly intriguing. Spatial segregation fell for each of the four groups examined and did so largely through a combination of ageing or cohort replacement and status change. Selective migration does reinforce spatial segregation but it appears as a weak process offsetting the effects of status change and other processes only to a limited extent. This is in line with the findings reported in our earlier work (Bailey and Livingston 2008) and is at odds with studies that suggest selective migration is the dominant force in neighbourhood change.

Identifying the processes by which change occurs is not the same as identifying the causes, but it does provide a more informed starting point for such discussions. In raising questions about the role of selective migration as the driver of changes in spatial segregation, this work challenges researchers to focus on new kinds of explanation for segregation. In our discussion, the role played by ageing and the life course has been highlighted, through the 'demographic conveyor'. Other explanations for the patterns observed may be to do with economic cycles (a factor emphasised in some of the US literature on poverty neighbourhoods [Jargowsky, 1997]) or with structural changes. On the latter, it is possible that changes in lifestyles or residential preferences are producing a re-ordering of urban space, for example, through the increasing demand for urban living. If this is the explanation, then adjustment may initially produce a reduction in segregation only to be followed by a return to segregation later on.

Yet another explanation may be that people are more reluctant to adjust their residential location to reflect changing social status than sometimes assumed. Where they have seen dramatic falls in income, they may be sheltered from the need to move to a cheaper neighbourhood by social security transfers, by savings or by the erosion of mortgage payments through inflation, or they may be willing to re-prioritise expenditures to housing costs in order to remain. Where people have seen incomes rise, they may be content to remain in places they know and around which they have built routines and social networks. Movers – the people who make up selective migration flows – may therefore be unusual.

As a preliminary analysis, there are some limitations which should be noted, which are also directions for future research. One caveat is that it has not been possible to look at segregation on the basis of income or wealth due to the limitations of UK Census data. Since income and wealth are more direct indicators of a household's ability to afford housing in

more affluent areas, it is possible that migration would be more selective with respect to these indicators that the ones used here; migration may not be selective with respect to educational status, for example, because affluent degree holders cannot be distinguished from poorer ones. Nevertheless, it should be noted that the results for status change give us reasons for some confidence as these flows do have the expected impacts on segregation.

Second, the paper presents results for one particular group in one context – the working age population of Scotland during the 1990s. It is unclear to what extent the pattern of change observed here is unusual, due to the economic climate or particular aspects of the housing or neighbourhood system. Further work might cover other time periods for Scotland including the recent recession, or look at variations within Scotland between cities which experienced rather different economic contexts (depressed Glasgow versus booming Edinburgh, for example). Earlier work showed that the strength and direction of selective migration flows varies with the tightness of housing and labour markets (Bailey and Livingston 2008). Further comparisons might be usefully made with countries with much looser planning systems and housing markets, such as the US.

Third, research might explore how the balance between adjustment processes varies between different kinds of neighbourhood. As noted above, research on deprived neighbourhoods has argued that selective migration has been a particularly strong feature of those areas, undermining the efforts of public interventions. This might also give more direct comparability with some of the US studies discussed earlier. Using this framework to explore change for individual neighbourhoods or groups of neighbourhoods would reveal whether migration is particularly problematic in those contexts. If selective migration were a more significant factor in more deprived neighbourhoods, that would fuel criticisms of area-based interventions. Equally, the analysis might reveal that worse rates of status change were the

key factor maintaining concentrations of deprivation, with rather different implications for policy.

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